

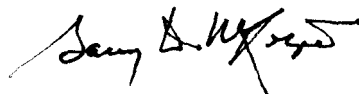
Senior Thesis

Earth Science Education:
Hands-on Activities and Other Resources Aiding Elementary School Teachers

By
Deborah L. Smith
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Dr. Garry D. McKenzie

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Smith, D. L.

Introduction

A great tragedy is taking place in our nations classrooms. Our children are being deprived of the lessons that help develop critical thinking skills, observational skills, analytical skills and other skills that help develop well-rounded adults. Our children are being deprived of science, in particular the most unifying area of science, Earth Science. In classrooms where science is being taught it often occurs by ineffective means. As a nation we need to improve the quality of science education in our nation's schools. One way in which we can achieve this is by incorporating hands-on Earth Science activities into the curriculum. Some questions do arise with such a proposal. First of all, why is Earth Science so important? Secondly, how do hands-on science activities help teach science better? This paper explores these questions, provides sample hands-on activities, and other resources helpful in teaching hands-on science.

PART I

Why Earth Science?

First of all, what is Science? Science is essentially our attempt to understand our surroundings, and our position in them, or in other words our attempt to understand our Earth system (Mayer, 1992). According to this definition, it is reasonable that our scientific focus should be Earth Science. The goals set forth in *Ohio's Model Competency-Based Program (OMCBP)*, also agree with this sentiment (see table 1). Many of these goals exhibit desired outcomes consistent with lessons taught in Earth Science classrooms, such as exploring interactions within the natural world. According to *OMCBP* scientific literacy develops when science education programs include a wide

variety of activities that emphasize learning from local and global settings and decision-making in real world settings among other things. These two points emphasize the importance to education of understanding the whole world and our place in it. Earth Systems Education, which is deeply rooted in the Earth Sciences, supports this kind of global education, by presenting a representation of the nature of science that is over all more inclusive (Merryfield, 1997). This provides us with a way of understanding the various Earth systems that interact with each other.

According to OMCBP inter-disciplinary connections are also important in developing scientific literacy. The national standards on the subject of Earth and Space Science provide an excellent framework for an entire science program including all other types of science (Merryfield, 1997). For example, biology, chemistry, and physics all have connections to Earth Science. Not only can Earth Science easily incorporate other sciences it is also an important tool in connecting other disciplines. Earth Science is important in political science and business so that our economists, politicians, and businessmen use our precious natural resources responsibly (Mayer, 1995). Earth science is also connected to art and music through some simple understandings about Earth Systems Education that have been set forth. The first understanding emphasizes the aesthetic values of the planet Earth as interpreted through art, music and literature (Mayer, 1992). It is evident that the possibility for Earth science integration is almost limitless.

Finally we must all learn to appreciate our responsibilities as residents of the planet. Earth Science deals with change on two levels, one level is that of millions of years, such changes include the movements of the Earth's crust through plate tectonics.

The other level is that of decades or centuries. The human population dramatically affects these changes. Understanding these changes is very important for the future health of our home for us and for future generations (Mayer, 1992).

Why hands-on science?

In order to effectively teach science, one must capture the attention of the students. Hands-on demonstrations and experiments do just that. *OMCBP* suggests that science content be effectively learned when the student is actively engaging in investigations of the world. Reading the textbook and doing problem sets does not accomplish that objective. *OMCBP* goes on to state that real-world activities (hands-on) goes a long way to aid the development of science literacy, implying that when activities are hands-on student's minds are on. Additionally *OMCBP* states that through experiences, including scientific explorations of the world, students will be able to understand a large range of material. These experiences prepare the students to identify problems and find or develop solutions scientifically; recognize and synthesize scientific knowledge and methods; develop scientific problem-solving skills; and finally to make informed evidence-based decisions at various points in their lives. In short, hands-on science activities are stimulating our children to become critical thinkers, a very important trait to possess in this world.

PART II

Choosing appropriate activities

Many factors must be considered when choosing hands-on activities for the classroom. These factors work as a filter letting only the appropriate activities through (see Table 2). The first factor, **safety**, is very important. If the activity is not safe it has no business in the classroom. Some activities might require the use of a hot plate, which may be safe with older children but is most likely a safety concern with younger children unless additional supervision is available. If the activity has been deemed safe we may move on to the next factor, **meaningful learning**. The activity must: 1) be appropriate for developmental level of the students, 2) lead to an accurate representation of the scientific concept being presented, and 3) keep the student's interest. If the activity has made it this far we then decide whether it ^{is worth} the **time and money** needed for it to work. These two factors are closely related. If the activity takes a long time (1 hour or more) or costs a significant amount of money (>\$20) it should meet many more learning objectives than an activity that takes only about 30 minutes and is essentially free. Finally **does the activity work?** It is very important that you try the activity first before you ever even introduce it to the class.

Sample activities and objectives

Activities in this section are designed for 4/5 grade students.

1. This Rock is Your Rock, this Rock is My Rock.

Source: On the Rocks p.18-19

Estimated time required: 30-40 minutes

Objectives:

1. Help students develop good observation skills
2. Students learn that rocks are made up of one or more minerals.

Materials:

1. Enough different rocks or minerals of similar size and shape for each student to have one. (Rock and mineral samples may be obtained through geology departments, state geological surveys, science supply companies, rock and mineral clubs, etc.)
2. Hand lenses (if available)
3. Pencil and Paper

Procedures:

1. Give each student or pair of students a sample and a hand lens (if available) and about 10 minutes to examine it. Have students describe their sample noting color, weight, size, shape, etc.
2. Collect samples and display at a single location.
3. Have students exchange their original description with another student or group.
Using the exchanged description the students will then try to find the correct sample from those on display.
4. Repeat several times.
5. Discuss revisions to original descriptions.

2. Oil Slick

Source: Adapted from Earth Child 2000 p. 190

Objectives:

1. Students will learn about environmental hazards such as oil spills.

2. Students will develop problem-solving skills.
3. Gain a sense of teamwork.

Materials:

1. Large bowls or baking pans (enough for each group to have one)
2. Large bin to collect waste materials (one or two for entire class)
3. Water
4. Vegetable oil
5. Graduated cylinder
6. Baster
7. Cotton Balls
8. Old Towels
9. Large Spoon
10. Corn Starch (or other absorbent powder.)

Procedure:

1. Assign 3 or 4 students to each group. Each group should get a pan or bowl. Each group will receive the same amount of water and the same amount of oil. Give students about 15-20 minutes to remove as much oil as possible and as little water as possible, using the supplies provided, such as the baster, the spoon, cotton balls, etc.
2. At the end of the allotted time have the students pour the remaining oil and water into the graduated cylinder, measuring how much oil and water are left.
3. Discuss successful methods and ones that may have caused more harm than good.

Activities incorporating other subjects

1. English / Language Arts

Water Words

Source On the Rocks p.73

Objectives:

1. Get students thinking about how important water is to their lives
2. Promote creativity and English language skills

Materials:

1. Paper and pencils
2. Large flip chart or chalk board

Procedures:

1. On flip chart or chalkboard draw a large circle, labeled water, in the center. Draw six smaller circles around the outside that intersect with each other and the large circle. Label these “DESCRIPTORS,”(words that describe water, such as wet) “RECREATION,” (activities you do in water, such as swimming) “SIGHTS,”(things you see by water, such as the beach) “USES,”(things you use water for, such as cooking) “ANIMALS,”(animals that live in or around the water, such as fish) and “WEATHER.”(Weather phenomenon involving water, such as rain) Discuss how the six categories overlap in nature and in our vocabulary.
2. Break group into teams and assign one category to each team, each team should try to list as many words as possible.
3. After about 5 minutes have one person from each team read their words out loud compare totals have other teams suggest additional words.

4. Have students make up a story with the word list.

Part III

Other Resources

In addition to hands-on activities there are other materials available to help integrate the elementary classroom. Selecting reading books with an Earth Centered theme is one helpful way. This allows the teacher to prepare science units that coincide with a reading assignment on a similar theme. Earth Teacher 2000 (a supplement to Earth Child 2000) has an excellent guide to choosing environmentally sound reading materials (see Table 3). There are also a plethora of wonderful web sights geared towards hands-on science activities. One particularly good web sight is one run by Wright State University's Geology Department: www.geology.wright.edu/geology/k12/k-12.html . This web sight has an extensive list of activities and links to pages full of activities. The activities featured on this page, also do an excellent job of keying out the performance objectives attainable by each experiment, as set forth by OMCBP.

Conclusion

Suggestions such as the ones previously mentioned will help fill our elementary schools with science. This can only happen when teachers encourage the students to be critical thinkers. As we have already discovered hands-on science activities and other integrated learning approaches help tremendously in making that a reality.

Tables

**Table 1 Science: Ohio's Model Competency-Based Program
GOALS**

Goal 1: The Nature of Science. To enable students to understand and engage in scientific inquiry; to develop positive attitudes toward the scientific enterprise; and to make decisions that are evidence-based and reflect a thorough understanding of the interrelationships among science, technology and society.

Goal 2: The Physical Setting. To enable students to describe the relationships between the physical universe and the living environment, and to reflect upon and be able to apply the principles on which the physical universe seems to run.

Goal 3: The Living Environment. To enable students to describe the relationship between the structure and functions of organisms, to assess how organisms interact with one another and the physical setting, and make decisions that ensure a sustainable environment.

Goal 4: Societal Perspectives. To enable students to analyze the interactions of science, technology and society, in the past present and future.

Goal 5: Thematic Ideas. To enable students to use major scientific ideas to explore phenomena, inform their decisions, resolve issues, and solve problems: and to explain how things work.

TABLE 2 SCIENCE ACTIVITY FILTER

1. Is the activity safe?
2. Is there meaningful learning?
3. Is the time needed for the activity balanced by the amount of learning?
4. Is the cost of the activity balanced by the amount of learning?
5. Is the level of difficulty appropriate for the students?
6. Does the activity work?

Source: Science is a Study of Earth

Table 3: Book Selection Checklist

1. Is it a book in which meaningful contact is made between a character and the natural world
2. Is a “sense of wonder” about the natural world conveyed?
3. Does the book foster understanding and/or how it works?
4. Does the character demonstrate positive feelings about the natural world?
5. Will this book encourage children to act on what they have come to understand?

Evaluation: A score of 2 or more yes answers indicate that the book would be an environmentally sound choice.

Source: Earth Teacher 2000

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